Who Moved Those Rain Clouds to Town? Making Windbirds to Learn about the Power of Wind

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Abstract

In this practical article, a kindergarten teacher shares a lesson designed to teach students about the power of wind. To address the Next Generation Science Standards engineering standards, students discussed the negative and positive aspects of wind and made daily weather observations (K-ESS2-1). Students constructed bird-shaped windsocks, called windbirds, to explore how the shape of the object allowed it to move in the wind (K-2-ETS1-2). To address the National Core Arts Standards, creative arts were integrated as students designed cylindrical windbirds of colorful materials. The windbirds were used to observe the effects of wind in the students' outdoor environment at school. Students read both fiction and nonfiction books to increase their understanding of wind related concepts, learning how windmills can harness the power of the wind (K-ESS2-1). The article provides a review of related literature and a detailed plan of the lesson taught by the teacher.

Key Words

Arts-integration, STEM education, STEAM education, wind, windsock, NGSS, practical article.

Introduction

Common practice for kindergarten students includes making observations of local weather conditions to develop an understanding of weather patterns over time as prescribed by the Next Generation Science Standards (NGSS Lead States, 2013). This article highlights a kindergarten classroom and activities that engaged students in exploring the wind. Students used creative arts to self-select materials to construct a windbird that functioned as a windsock. They read children's books to increase their understanding of concepts related to wind and wind power. Finally, students had the opportunity to make observations of the wind's impact on their windbirds in the outdoor environment at their school.

Literature Review

During the early childhood years, it is natural for children to acquire knowledge related to science because they are attempting to make sense of their world (Roseno, Geist, Carraway-Stage, & Duffrin, 2015). Blake (2009) pointed out the need for early childhood teachers to nurture this natural curiosity about science (Roseno et al., 2015). According to Piaget, direct instruction is not an effective way to alter a child's way of thinking. Rather, children need numerous

opportunities to interact with the environment (Roseno et al., 2015). Piaget's constructivist theory promotes the idea of teachers as facilitators, rather than transmitters of knowledge. Teachers who hold constructivist beliefs provide children with opportunities to explore the world using everyday experiences. Furthermore, these teachers take into account the prior knowledge of students, encourage observation, and assist students in making connections between experiences (Broderick & Hong, 2011). A constructivist approach to teaching is common in early childhood settings and supports a developmentally appropriate way of teaching science concepts to young children.

Effective Pedagogy for Science

Hoisington, Chalufour, Winokur, and Clark-Chiarelli (2014) offered five key teaching practices designed to promote learning in science. First, it is necessary for teachers to offer children an environment that allows for science inquiry. Secondly, teachers should offer experiences that support conceptual understanding. Thirdly, scientific practices should be encouraged in the classroom. Next, investigations should be part of the curriculum. And finally, teachers should have a plan in place to assess each child's learning and engagement in inquiry. The researchers also stressed that questions requiring one correct answer should be avoided. Instead, teachers should prompt students with questions that foster investigation. These questions should help children talk about their observations, explain the reasoning processes behind those ideas, and prompt them to make predictions based on their prior experiences and what they believe will be the result of their investigations (Hoisington et al., 2014).

Previously Published Wind Lessons

Miller, Smith, and Trundle (2014) addressed the NGSS in a classroom science unit about weather with kindergarten students. Students talked about flying kites and went outside to observe signs of the wind. Students made qualitative observations while simulating wind with a hair dryer on different speeds. The students returned to the outdoor environment to observe the school's flag and feel the wind on their faces. These daily observations were recorded. "These early experiences with scientific phenomena help young children begin to develop their basic inquiry skills and science content knowledge and lay a foundation for future learning" (Miller et al., 2014, p. 54). Children's literature was also integrated into the lessons. This enabled students to make connections between their inquiry experiences and the information conveyed in the books. Quality non-fiction books with photos that complement the topic of study are also characteristic of inquiry based lessons. These books can be used to teach and reinforce vocabulary related to science (Sharapan, 2012). A study by Hoffman, Collins, and Schickendanz (2015) focused primarily on informational texts. They found this genre was an effective means to increase knowledge about science concepts for young children.

STEAM Education

The term STEAM (Science, Technology, Engineering, Arts, and Mathematics) is often associated with science inquiry in early childhood classrooms. STEAM involves integrating the arts with science, technology, engineering, and math. It has emerged as a way for early childhood teachers to address science concepts and build a foundation for later learning (Sharapan, 2012). According to Sharapan (2012), STEAM is not about facts and correct answers. Rather, it encourages teachers to facilitate activities that promote discovery and inquiry through use of the arts. Addressing science in early childhood fosters a child's natural curiosity. Everyday experiences, such as the wind blowing during a rainstorm, drive this curiosity (Sharapan, 2012). According to Love and Strimel (2013), students are more likely to retain knowledge when their experiences are real and relevant to their everyday lives.

Standards Addressed by the Lesson

This lesson on investigating wind and making windbirds supported several Next Generation Science Standards (NGSS Lead States, 2013). The lesson set previous to this unit on wind focused on the water cycle. Students made daily observations of the weather during that time and continued through the wind investigation. This work aligned with K-ESS2-1: Use and share observations of local weather conditions to describe patterns over time. This

standard was addressed when students made daily observations of wind and the wind's effect on the windbirds.

Another standard addressed by the lesson was K-ESS2-2: Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs. This standard was addressed when students discussed how windmills generate electricity and pump water for irrigation. Finally, students engaged in activities that fit with K-2-ETS1-2: Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem as they constructed their windbirds.

Another standard, KPS2-1: Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object was addressed. Students had the opportunity to go outside and observe how the wind affected their windbirds as they hung from a tree and when they held the windbirds and ran down a hill.

In addition to standards from the NGSS, this lesson also supported the National Core Arts Standards (National Coalition for Core Arts Standards, 2014). In particular, Kindergarten standard VA:Cr2.3.Ka: Create art that represents natural and constructed environments was used as students created birdlike windsocks to see the effects of the wind.

The lesson complied with Iowa Core Math Standards (Iowa Department of Education, 2012), specifically, K.G.A.1: Describe objects in the environment using names of shapes, and describe the relative positions of these objects using terms such as above, below, beside, in front of, behind, and next to. When students made the windbirds, they had to position the eyes, beak, and tail on the bird to make sure that it resembled a realistic bird.

Finally, Iowa Core Reading Standards (Iowa Department of Education, 2012) were supported by the lesson activities. During reading of wind-related texts, the following standard was addressed: RI.K.1: With prompting and support, ask and answer questions about key details in a text. Students also practiced RI.K.2: With prompting and support, identify the main topic and retell key details of a text. During investigations and discussions, students also satisfied RI.K.IA.1: Employ the full range of research-based comprehension strategies, including making connections, determining importance, questioning, visualizing, making inferences, summarizing, and monitoring for comprehension.

Method

The main idea of the lesson was to encourage the students to explore the power of wind by creating a windbird to observe patterns of the strength and direction of the wind. They investigated how the strength of the wind, direction of the wind and weight of the material used for the windbird affected the motion of the windbird. Students used their knowledge of shapes and positional words to create and describe their windbird and how it worked. For example, the windbird was shaped like a cylinder. The students decided the body of the windbird should be shaped like a long, narrow cylinder as opposed to other shapes. This decision was based on student knowledge related to how things fly. They commented the windbirds should be lightweight or they wouldn't fly. They mentioned birds, kites, and planes in their discussion. Before they constructed the windbird, all of them noted that the windbird wouldn't fly if it were big and fat. The windbird had circles for eyes and a triangle or a rhombus for a beak. They had to position the two eyes above the beak and the tail at the lower end.

Students wrote persuasive letters to the Teacher Librarian to buy the book, *The boy who harnessed the wind,* for the school library, outlining what they had learned from the book and also reasoning why they recommended the book. This lesson was taught over one week. The preceding lessons addressed the water cycle. This lesson was followed by a lesson on recycling and Earth Day. Elements of the 6E model were used as a basis for the lesson plan sequence (Peters & Stout, 2011).

Participants and Setting

This lesson was taught in a kindergarten classroom in an elementary school that receives Title 1 assistance. Five female students and seven male students between ages five to eight years were involved in the lesson. The home language of all participating students was English.

Materials and Equipment

Several books on wind, both fiction and nonfiction were used during this lesson: *The boy who harnessed the wind* (Kamkwamba & Mealer, 2015); *The wind blew (*Hutchins, 1993); and *Wind* (Cannons, 2014). The teacher used a world map and a globe to show the students where Malawi was located with proximity to the equator, comparing it to the United States. The teacher wanted to convey the lack of access to water and the problems that this caused for the people of Malawi. The students needed to understand the lack of rain and absence of running water.

For construction of the windbird, students were given a choice of tissue paper, cellophane, felt, cloth (both polyester and cotton), card stock, aluminum foil, clear shrink film sheets, foil paper, foam and construction paper to make the body of the windbird (Figure 1a). Each sheet needed to measure 9 × 12 inches (22.5 × 30 centimeters) to be the main part of the windsock. Tagboard strips of two sizes, 1.5 × 13 inches (3.8 × 33.0 centimeters) and 1.5 × 10 inches (3.8 × 25.4 centimeters) were needed for the frame (Figure 1b). The windsocks were made into birds with the addition of feathers and tissue paper scraps, circles drawn on yellow construction paper for eyes, and additional yellow paper for beaks. Finally, markers, scissors, book tape, clear tape, glue, twine, and a hole punch were the other materials required in construction of the windbirds. The teacher used a computer to project on a screen the 1877 oil painting, Paris Street; Rainy Day by the French artist Gustave Caillebotte (Art Institute Chicago, 2016). In a later lesson, the teacher also showed a short video clip of William Kamkwamba (Kamkwamba, 2007).

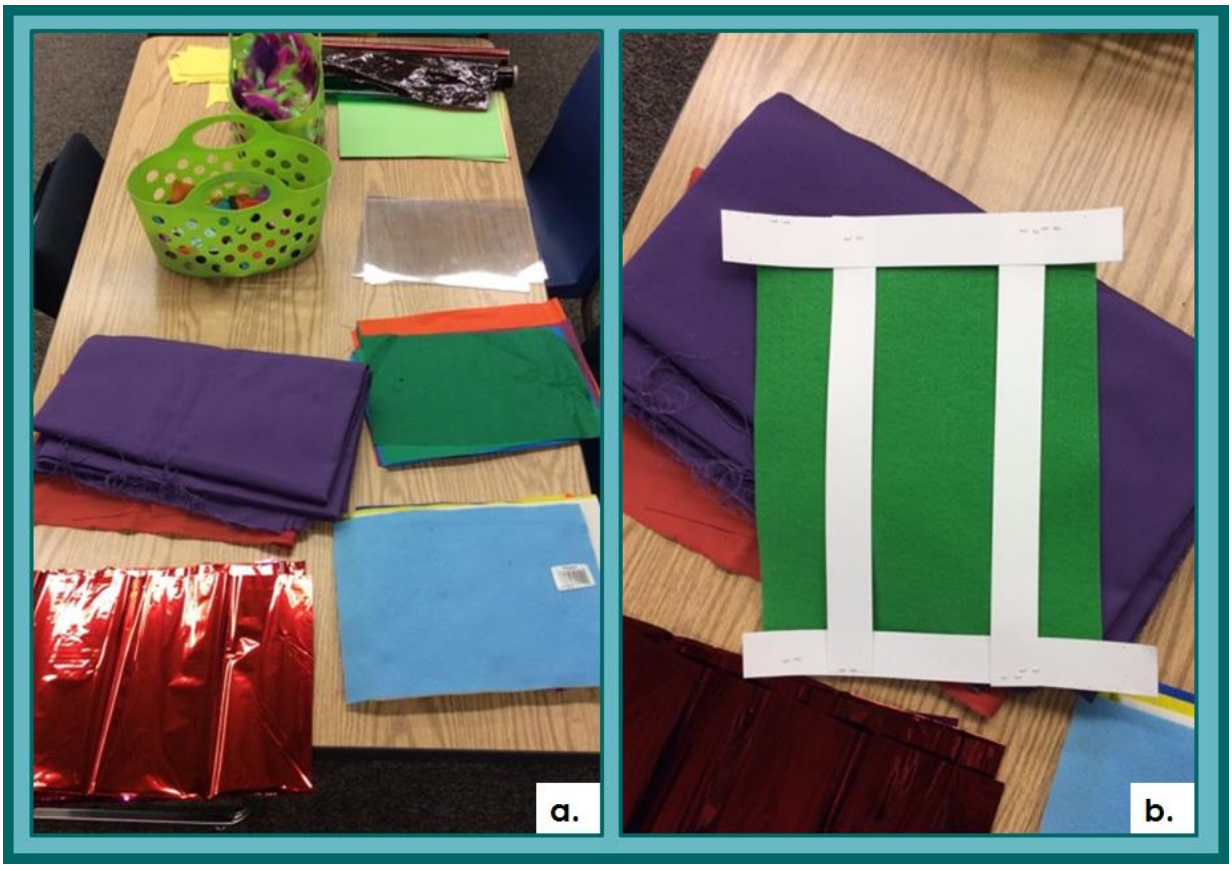

Figure 1. Materials needed for construction of windbirds.

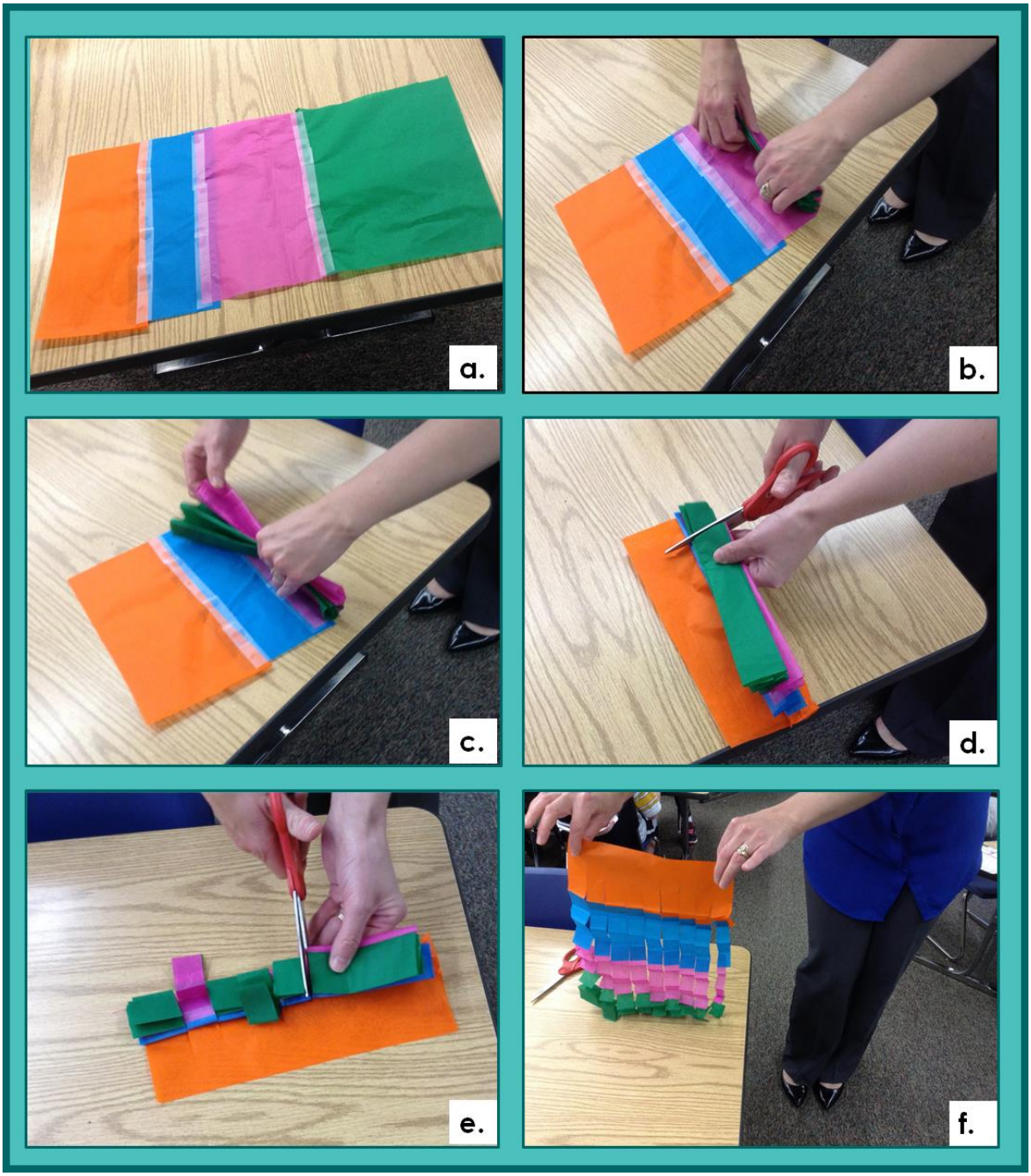

Figure 2. Steps in making the tail. Figure 1a shows the four colors of tissue paper taped together; 1b and 1c show the paper being folded back and forth to produce a fan fold; 1d and 1e show the folded paper being cut into several folded strips; 1f shows the finished tail made of strips.

The Lessons

Engagement Activity

The teacher showed an image of the 1877 oil painting Paris Street; Rainy Day by the French artist Gustave Caillebotte (Art Institute Chicago, 2016), on the projector. This image shows people walking on a shiny wet street with opened umbrellas. The discussion focused on how realistic the city scene looked, how wet the paved streets appeared, and the how the sky was filled with rain clouds. Students responded to two questions: How do rain clouds move? How does it rain in a place where there is no large body of water present for water to evaporate and form a rain cloud? The teacher used the first question as the title of lesson to help the students make a connection between their recent study of rain to the new topic of study, the wind. Students' answers to these questions were based on their recently acquired knowledge of the water cycle. Most of the answers included the words, "cold stuff, pushing, and blowing." Two students said that cold air moves the wind. Although the students hypothesized a connection between the wind and the water cycle, they were unable to explain that connection.

Exploration Phase

The class went outside to observe the movement of the clouds. Students observed that the clouds moved in one direction once and in another direction the second time. The teacher asked the students two focused questions: How do the clouds move? What is wind? Many students said, "The clouds were really big, but some clouds were really small." Another observation was, "Even the really big clouds move as fast as the small clouds."

Explanation Phase

On the first day of this part of the lesson, the teacher read the books, *The wind blew* (Hutchins, 1993) and *Wind* (Cannons, 2014). She explained that wind is air moving in different directions. The teacher discussed how wind moves air around the world on land and across the oceans, telling how it can bring cold or warm air depending on the season. New vocabulary words were explained: breeze (gentle wind), gale (a strong wind), tornado/ twister (a strong spinning tube of air), hurricane (very strong wind that starts over a warm ocean and that may come toward land).

The students were more familiar with the negative effects of the wind such as the damage from tornadoes than with the positive aspects of the wind. The class then discussed how wind can bring rain by moving rain clouds, how wind can shape landforms, how wind can propagate seeds, and how wind can be used as energy.

Students considered a focus question, "As it is invisible, how can we observe and measure the wind?" Students were familiar with the concepts of kites, windsocks, and pinwheels. All the students agreed that any object that can measure the wind should be made of lighter material so that it can be "lifted up" by the wind and be moved around. At this point, the teacher clarified the terms "heavy," "light," "big," and "small." Several objects, such as books, paper, a balloon, marbles, large plastic bags, and blocks, were used to observe how the weight of an object impacts its movability by the wind more than the size of the object.

On the second day of the unit, the teacher used the book, *The boy who harnessed the wind* (Kamkwamba & Mealer, 2015). A six-minute video of a TED Talk by the author (Kamkwamba, 2007) was shown. The students learned how William lived in a village with no water for irrigation and electricity, how he had to drop out of school when they started eating one meal a day, how William went to the library and read about a windmill that helped to generate electricity and pump water, and how he built a windmill out of scraps to get electricity and pump water for crops.

Expansion Phase

The class decided that before making a tool to control the wind such as William did in the book, the class needed to establish that there is enough wind to control. The class decided to invent a tool to measure the strength and the direction of the wind in the school yard over a period of time (supporting NGSS-K-ESS2-1). Also, the students decided to make the tool to look like a bird, since birds fly in the wind (supporting NGSS K-2-ETS1-2).

Students selected the material for the body of the windbird from those provided by the teacher. All the students

selected the lighter materials such as cellophane, a transparency sheet, or tissue paper. See the earlier section titled “Materials.” Feathers and tissue paper scraps were available for decorating the body of the windbird (Figure 4). Yellow construction paper circles with pupils made with black markers were used to make the windbird's eyes (Figure 3a and 3c). Students used scissors to cut a piece of yellow construction paper to make the beak (Figure 3b and 3d). A long tail for the bird was made by taping together strips of colored tissue paper (Figure 2a) and folding them into a fan (Figure 2b and 2c). A strip about 1.5 inches (3.8centimeters) long was left unfolded. Then, the teacher cut into the fan at an angle, cutting it into folded strips at very close intervals (Figure 2d and 2e). The unfolded strip (Figure 2f) was glued to the body, forming a long tail for the bird. Glue was used to affix the feathers and tissue scraps to the windbird body. A stapler was used to fasten the tag board strips and make the cylindrical body of the windbird. Book tape and clear tape were used to seal the edges of the seams. Two holes on the top strip of the cylinder were punched to pass a twine to make a handle. Figure 4 and Figure 5 show windbirds being constructed and awaiting their tails, respectively. The students were most interested in creating the windbirds. They were excited when presented with the materials and the opportunity to select the materials for the construction of their windbirds. They were especially drawn to the bright, colorful materials. Because they wanted the construction to look like a bird, most of them had a clear idea of how they wanted it to look. Four students chose a transparency sheet for the body while the rest of the students chose colored tissue paper or cellophane. All students were able to complete the project. There were no students in the classroom with special needs; however, the teacher made the decision to staple the windbirds for the students. This was due to the fact that stapling the windbird was rather awkward and seemed to be beyond the capability of most of the students, particularly those who chose a transparency sheet for their design. Figure 6 shows completed windbirds.

Figure 3. Construction of windbirds. Figure 3a shows circular eyes being cut out; 3b shows the beak being cut; 3c shows pupils being marked in the eyes; and 3d shows glued features and the interior of the mouth being made red.

Figure 4. Art integration in construction of windbirds.

Figure 5. Three windbirds awaiting their tails.

Figure 6. Two boys with their windbirds

Evaluation

Once the windbirds were completed (Figure 6), the teacher helped students hang them on a tree (Figure 7). Everyone watched them move with the strength and direction of the wind. Because all students selected appropriate material that was light, all windbirds flew in the air as expected. By observing the movement of the windbirds, students could decide if the wind was a light breeze, a gust, or if the air was still without any wind. They could also gauge the direction of the wind easily as the long tails flew in the air. The students were able to see and feel the impact of the wind as they held their windbirds and ran down a hill (Figure 8). These activities provided an opportunity for Standard K-PS2-1 to be addressed. The students investigated how the wind pushed the windbird on the tree and made it move, and also the way the wind pushed it as they ran down the hill.

The primary forms of assessment of student learning were observation and discussion. The teacher observed each student's ability to construct a windbird that could fly. The teacher also made observations while the students took their windbirds outside to experiment. The teacher asked several questions to evaluate student understanding. These questions addressed the direction the windbird flew and the movement of the windbird based on the force of the wind. If the lesson were to be taught again, the teacher would assess the students beyond informal questioning as a large group. Questions could be posed to individual students to clearly assess understanding of concepts related to the wind. These questions might include: (a) What are some things that the wind moves? (Clouds, hair, swings at school, curtains if the window is open); (b) What makes the clouds move? (Wind); (c) How do you know what direction the wind is moving? (You can hold up a windbird and see the way it flies or you can look at the trees); and (d) How can you tell if the wind is light like a breeze or strong like a tornado? (If the leaves are moving just a little, it is a breeze or if you hair blows in your face and you can't see, it is a strong wind.)

Figure 7. Windbirds hanging from a tree being tested in the wind. This activity addressed Standard K-PS2-1.

Figure 8. Feeling the tug of the wind on a windbird while running

Conclusion

The lesson was very successful, largely due to the fact that the students had 'invented' a rain boot for a previous lesson and they were getting an opportunity to invent another tool for an authentic purpose. Another crucial component for the success of the lesson was the artistic freedom that the students were given to select the material and to design the windbird's body. One important factor in this lesson was having bright, bold, cheery-colored material (as resplendent birds) for the bodies of the windbirds. The teacher also taught the students that in some countries, simple structures like these are used as scarecrows (e. g. Nuttle, 1987). What was most evident was student enjoyment during the lesson activities. The students were very engaged while creating their windbirds and experimenting with their creations in the outdoor environment. Weeks after the lesson had ended, several students commented that their favorite thing in kindergarten was making and flying the windbirds.

There were several insights that the teacher had from the lesson set. In the future, she would like to make these windbirds out of found/ recycled/ repurposed material as the theme following this unit focused on recycling. Also, the main character in the book, *The boy who harnessed the wind*, William, made his entire windmill using material from a junkyard. That idea was very inspirational for the kindergarten students. In their persuasive letters to the teacher librarian, all the students mentioned the reasons the book appealed to them personally (Figure 9). A student who had an older sibling

mentioned in her letter, “He was only 14 (when William made the windmill).” Several students mentioned the fact that the windmill was made out of garbage. The whole idea of a village not having electricity or water, the experience of a famine, and a child not much older than them “controlling” the wind and saving the village awed the students. The fact that students recognized the boy was able to meet the needs of his village supports student understanding of K-ESS2-2 related to how humans can change the environment to meet their needs. The teacher highly recommends this book.

Perhaps, the best outcomes of this lesson were that students learned the importance of the wind as a source of energy, a source of seed propagation, and as an agent in the water cycle. Students had the opportunity to investigate the normally invisible power of wind through their creative windbirds.

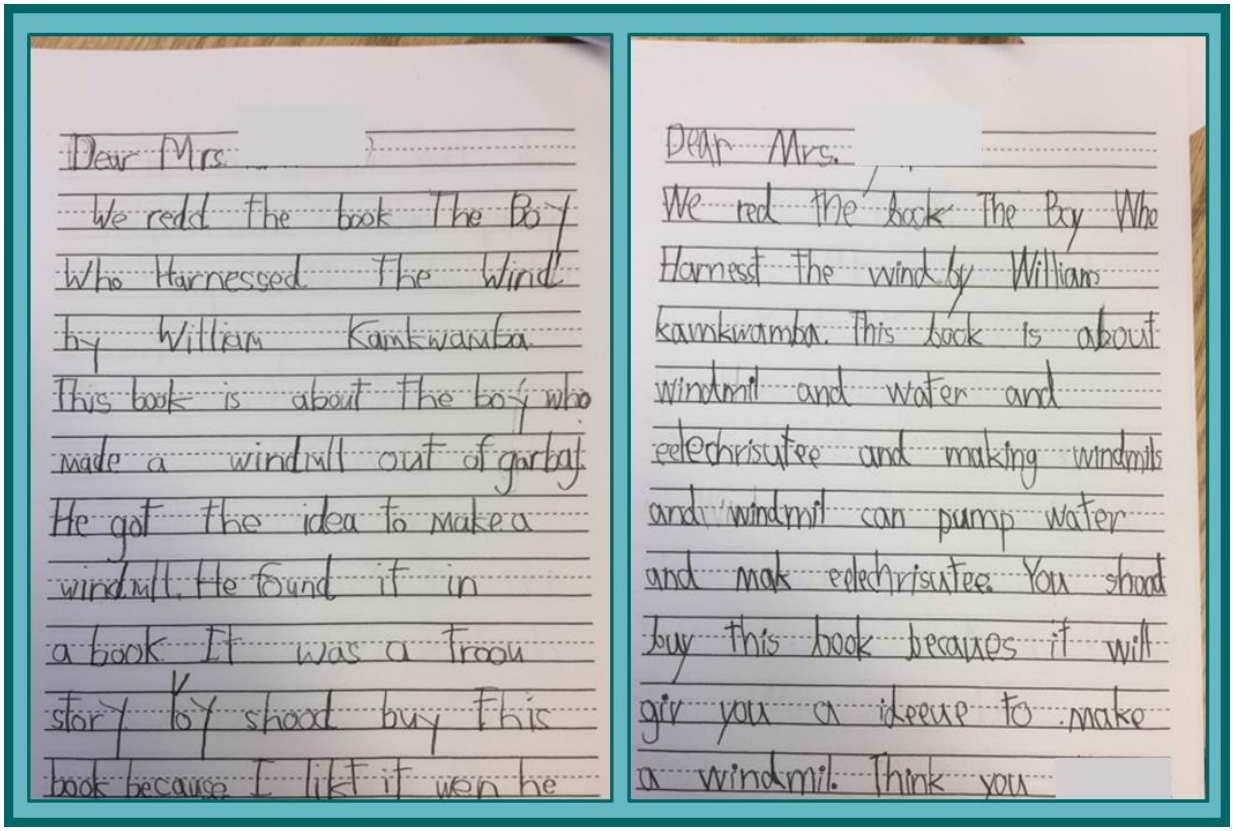

Figure 9. Two students’ persuasive letters about a book the class read.

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